

PITTING CORROSION NUCLEATION ON STAINLESS STEEL MONITORED BY IN SITU ATOMIC FORCE MICROSCOPY

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Despite the progress made in understanding the embryonic stages of pitting phenomena, many questions remain unanswered. It is known that pitting will preferentially nucleate at weak points in the passive film. The sites at which pitting corrosion starts on the surface of a stainless steel have been the subject of much discussion (1,2). It has been suggested that local disturbances in the passive layer at non-metallic inclusions and other inhomogenities should make these areas more susceptible to chloride ions adsorption, which would initiate the pit nucleation. Experimental evidence of chemical and electrochemical reactions taking place at the surface of stainless steels during the nucleation of pitting had relied heavily on electrochemical measurements. There are only few surface and morphological data with which pitting corrosion theories can be compared. AFM method can provide a first direct measurements of near-atomic and atomic scale localised corrosion initiation and give a strong insight into the pitting initiation mechanism. In this work in situ AFM measurements combined by Scanning Electron Microscopy and polarisation measurements are used to study the firsts stages of pitting nucleation process.

During the experiments in 0.5 M NaCl solution at the open circuit the formation and dissolution of deposits at the inclusions was observed. This fact could be correlated with the current burst observed during electrochemical noise experiments attributed to metastable pitting phenomena (1). The morphological changes observed in situ had been attributed to dissolution of the MnS containing inclusions, resulting in a dissolution/precipitation of sulphur species around the inclusions site and oxidation of manganese species (3). At a potential superior to the critical pitting potential an instantaneous nucleation of numerous deposits, localised at different points of the steel surface was observed. The experimental observations indicated that

the deposit formation was not only at the observed inclusions. After 60 seconds the deposits disappeared and numerous pits were nucleated at the stainless steel surface (Fig. 1). Probably these pits were nucleated at the sites where deposits were present. The deposits seem to correspond to the already described chloride islands (4). These observations indicate that the observed inclusions were not the only sites for pit nucleation.

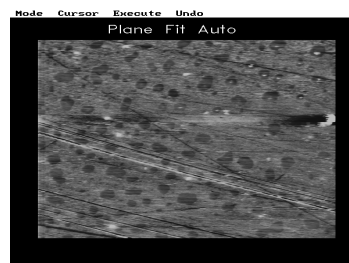


Fig. 1 Surface of AISI 304 stainless steel in 0.5 M NaCl solution, applied potential 260 mV.

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